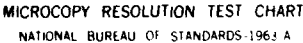AD-A136 577   DISTRIBUTED KNOWLEDGE BASE SYSTEMS FOR DIAGNOSIS AND   1/1
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REPORT DOCUMENTATION PAGE

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1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	Approved for public release; distribution unlimited.

4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S)
	AFOSR-TR- 8 3 - 1 2 4 2

6a. NAME OF PERFORMING ORGANIZATION Ohio State University	6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Air Force Office of Scientific Research
6c. ADDRESS (City, State and ZIP Code) Department of Computer & Information Science, Columbus OH 43201		7b. ADDRESS (City, State and ZIP Code) Directorate of Mathematical & Information Sciences, Bolling AFB DC 20332

8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR	8b. OFFICE SYMBOL (If applicable) NM	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-82-0255

8c. ADDRESS (City, State and ZIP Code) Bolling AFB DC 20332	10. SOURCE OF FUNDING NOS.			
	PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
11. TITLE (Include Security Classification) SEE REMARKS (ON BACK)	61102F	2304	A7	

12. PERSONAL AUTHOR(S)
B. Chandrasekaran

13a. TYPE OF REPORT Interim	13b. TIME COVERED FROM 1/7/82 TO 30/6/83	14. DATE OF REPORT (Yr., Mo., Day) NOV 83	15. PAGE COUNT 4

16. SUPPLEMENTARY NOTATION

17.	COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

In the original proposal the investigators had outlined a long term program for conducting research in knowledge based systems. In particular they proposed to study issues in diagnostic reasoning and in knowledge-directed information retrieval. During the first year most of the progress came in the area of diagnositic reasoning and in the conceptual foundations of knowledge-based systems in general. The investigators also developed an approach to a new type of task: design of mechanical parts. This report summarizes specific progress made in these areas.

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20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☒ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Joseph Bram	22b. TELEPHONE NUMBER (Include Area Code) (202) 767- 4939	22c. OFFICE SYMBOL NM

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

ITEM #11, TITLE:

"DISTRIBUTED KNOWLEDGE BASE SYSTEMS FOR DIAGNOSIS AND INFORMATION RETRIEVAL"

Accession For	
NTIS GRA&I	☒
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Unannounced	☐
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INTERIM REPORT OF SCIENTIFIC PROGRESS

ON GRANT AFOSR-82-0255

FOR RESEARCH ON

"DISTRIBUTED KNOWLEDGE BASE SYSTEMS

FOR DIAGNOSIS AND INFORMATION RETRIEVAL"

FOR PERIOD 1 July, 1982 -- 30 June, 1983

B. Chandrasekaran, Principal Investigator
Department of Computer and Information Science
The Ohio State University
Columbus, Ohio 43201

Submitted November 1983 to

Air Force Office of Scientific Research
Bolling Air Force base, DC 20332

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Technical Progress

In the original proposal we had outlined a l..ng term program for conducting
research in knowledge based systems. In particular we proposed to study
issues in diagnostic reasoning and in knowledge-directed information
retrieval. During the first year most of the progress came in the area of
diagnostic reasoning and in the conceptual foundations of knowledge-based
systems in general. We also developed an approach to a new type of task:
design of mechanical parts.

In particular, the following specific progress was made. (We will summarize
the nature of the result here and attach a paper in each case that gives
details of the results.)

1. We have elaborated our theory of **types of problem solving** that
   underlies expert reasoning. The idea is that a complex task can
   often be broken down into a number of **generic tasks,** for each of
   which a particular **problem solving regime** is appropriate. Each of
   these tasks can be solved by a **collection of conceptual specialists**
   among whom knowledge of the domain is distributed. These
   specialists solve the problem by engaging in that generic type of
   problem solving by exchanging messages of specific types. We have
   enclosed as appendix a paper, "Towards a Taxonomy of Problem
   Solving Types," which appeared in the AI *Magazine,* which gives the
   details of the theory.

2. In earlier work we had developed approaches to three generic types
   of problem solving: diagnosis, knowledge-directed data retrieval,
   What-Will-Happen-If type of reasoning. During the period of
   research under report, we formulated another important type of
   problem solving: design by refining plans. We have been applying
   the approach to the implementation of an expert system for
   mechanical design. The attached paper, "An Approach to Expert
   Systems for Mechanical Design," was presented at the IEEE Computer
   Society, Trends & Applications Conference.

3. We have developed (with support from another source) a tool for
   efficient construction of diagnostic expert systems. This tool is
   a high level language called CSRL. Under this grant support we
   have been experimenting with the application of this tool to the
   design and implementation of expert systems in the area of
   mechanical systems, since that was one of the domains that we
   emphasized in the original proposal. We reported on this language

at the last International Joint Conference on Artificial Intelligence at Karlsruhe. The paper from that Proceedings reporting on CSRL is enclosed. We also include with this report another technical report that discusses our experience in using this tool in the construction of an expert system for fuel systems for automobiles.

4. We have been investigating the issues related to how an expert system may have "deep" knowledge of its domain and use it to do problem solving, as opposed to the current generation of expert systems that use what one might call "compiled" knowledge. E.g. all the current expert systems in medicine have knowledge relating symptoms/manifestations and diseases explicitly encoded in the knowledge base. However, often a person who has an understanding of the domain will be able to derive these relationships from a deeper model. We have developed a language in which the understanding of an agent about how a device works may be encoded. This language expresses how a function of a device may be related to the behavior and structure of it and its components. In addition we have developed a compiler which can work on this functional representation and produce a diagnostic expert system. This result is of considerable significance we think, since it will enable for the first time a representation of "understanding" of a device. We have applied this methodology to the representation of the functions of a household electric buzzer and show how the compiler generates a dignostic problem solver from this. A paper reporting on this is attached as appendix to the report.

5. We have been looking into how capabilities of various expert system approaches can be characterized. A methodology by which a complex real world decision task may be decomposed into generic tasks and techniques suited for various generic tasks can then be applied is outlined in another attached paper, "Expert Systems: Matching Techniques to Tasks," which was presented as an invited talk at the New York University Symposium on Expert Systems for Business Applications. This will shortly appear as an article in a book of that title.

Personnel Activities

Two items of interest need to be mentioned here. Prof. B. Chandrasekaran, the PI for the Grant, spent 3 months at the MIT Laboratory for Computer Science as a Visiting Scientist during the research period. He worked with Prof. Peter Szolovits and Prof. Ramesh Patil on several aspects of expert systems. He also spent one month at Carnegie Mellon University under the sponsorship of Prof. A. Newell. A portion of his support for these visits came from the

AFOSR Grant. In addition to these major visits, Prof. Chandrasekaran gave a number of talks at BBN, GTE Labs, NRL AI Lab., and other places over the year.

Mr. Tom Bylander, a Graduate Research Associate under the Grant, won an award for travel to the International Joint Conference on Artificial Intelligence to present the paper on CSRL.

Computing Environment

Quite a bit of our effort went into gearing up for the introduction of Lisp machines into our computing environment. These machines will be arriving shortly. A number of changes will need to be made in the language environment: we are moving into an Interlisp environment, and many of our tools are being recoded for that environment.